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AUTHOR Di Vesta, Francis J.

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ABSTRACT

The Trait Treatment Interaction (TTI) Process approach is particularly adapted to the study of information-processing by receivers of information presented in the media. Differences in people's experiences do lead to different cognitive structures. Different people use the same machinery of perceiving, coding, storing, and retrieving. Neverthless, how they use this machinery, what information they process by this machinery, and which particular use of a given piece of machinery they prefer, will make a major difference in knowledge structures leading to an enormous variety of individual differences. Even very small differences in environment and experience can make large differences in knowledge structures including the learner's knowledge about how to process information, even though it is probably true that the underlying machinery is the same for all learners. Systematic investigations on the media based on TTI-Process oriented theories appear now to hold the promise of making a major impact on our understanding of the communication process as well as on our understanding of human behavior. In terms of the theories, technology, and research methods that the task requires there has never been a more opportune time. (WCM)

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Trait-Treatment Interactions (TTI), Cognitive Processes and Research on Communication Media*

Francis J. Di Vesta

The Pennsylvania State University

Researchers in media are in an excellent position to take advantage of the Trait by Treatment (TTI)-Process approach, the reasons for which may be best understood in historical perspective. Prior to 20 years ago the stream of media research was dominated by statistical methodology with only rare acknowledgement of a theoretical position. Characteristic of many fields at that time, the research took place within the context of what was then known as "dustbowl empiricism." Typical questions asked were: Can films teach? Can device X teach better than device Y? Is medium X better than medium Y for reaching a given objective? In those early studies, the device served as a source of independent variables: films, recordings, slides, and the like. Later studies were based on attempts to analyze the attributes of these devices, e.g., black and white versus color or still versus motion pictures. Some analysis was involved, but it can be seen that such variables are relatively gross ones and, more importantly, they are difficult to link to a theoretical framework. There is no need to cover these studies in detail for they are excellently reviewed in

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Lumsdaine's (1963) chapter in the first edition of the Handbook of Research on Teaching (Gage, 1963). The main characteristic of the conceptual analyses for these earlier studies was that they were atheoretical. They focused on the mode of presentation with occasional reference to more specific stimulus attributes.

Then, about 20 years ago, behavioral analysis emerged as a "theoretical" position which seemed compatible with the interests of media researchers. Skinner's (1961) functional analysis of behavior was applied to programmed learning and Miller's (1957b) behavioristic theory of learning was applied to communication through motion pictures. Recall that the latter appeared in a special issue of AV Communication Review edited by Miller (1957a). At that time both positions seemed to have potential for revitalizing media research. However, upon closer inspection, it can be seen that the emphasis of these positions was mainly on input-output relations. Broadly interpreted, Miller and Skinner suggested that conceptual analyses for studies of the media ought to be based on examining the effects of variations in stimuli on behavior.When motivation was considered important (and in Skinner's framework,motivational constructs are generally played down),it was viewed as a performance variable,that is,the behavioristic position implied that motivation encouraged the learner to increase his activity in some way without concern for its directing functions. Reward was seen primarily as an external condition without concern for its role in feedback and/or correction. Immediacy of feedback was considered an essential principle without concern for the several studies which demonstrated that immediacy of feedback in programmed learning,at least, did not facilitate learning (see a review by McKeachie, 1974).

In the main, studies in the behavioristic tradition focused on output, i.e., responses: Effects of practice on (some attribute of) responses. Time as it affects

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(some attribute of) responses. Programmed versus tutorial methods as they affect (some attribute of) responses. "Learning-by-doing" as it affects (some attribute of) responses. Such input, i.e., stimulus variables as the following were manipulated: time in the form of length of films or study time; size of step in programmed materials; amount of repetition in practice periods; static versus animated transparencies; and cues as prompters versus confirmers. Despite the emphasis on stimulus-response, some cognizance of internal processing by the learner was implied in the theoretical construct of mediational processes.

The potential of the media for studying learning and communication and for conducting such research within the context of a theoretical position became apparent during this era. It was, perhaps, because of this awareness that the audio/visual label was replaced by the term media and the communication label was adopted to indicate a concern for some (intangible) thing beyond input-output relations. Nevertheless, in this phase of media research, investigators were still restricted to looking for main effects of some very global kinds of variables.

The wave of enthusiasm in educational psychology, a field in which media specialists are very much a part, for a methodological approach known first as ATI (Aptitude by Treatment Interactions) and later as TTI (to take into account aptitudes in the broader sense of including any dispositional characteristic) seems now to be a logical next-step to these early developments. Indeed, it has involved research on media from the start. Rather than concentrating only on input-output variables the effects of interactions between some characteristic of the stimulus/task/treatment

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and of the subject/receiver/performer on responses/behavior were and are being investigated (see,for relevant reviews: Berliner & Cahen,1973; Cronbach, 1957; 1967; Cronbach & Snow, 1968). Rather than comparing only the effects of such broadly defined variables as static versus animated pictures, the researcher now has guides by which to search for generalizations based on the answer to the question (Cronbach, 1966):

With this kind of subject matter, and

Experiences of this type, in this amount,

What pattern of responses is produced,

In people with these abilities, aptitudes, or traits?

In practice, one, two, or three independent variables might be manipulated but, regardless of the number of independent variables they are always varied in conjunction with some status or individual difference variable...i.e., the investigator using the TTI approach considers the effect of the treatment as it interacts with some trait or traits of the subject. (See Figure 1 for a summary of approaches.)

Optimism for this approach stimulated a family of investigators during the 60's to embark on extensive programs of TTI studies. Most of these investigators belong to a Special Interest Group for TTI in the American Educational Research Association. Around 1970, however, some investigators became disenchanted because so few statistically significant TTI's were found, leading to the conclusion that the approach was unconvincing, unreliable, or had little payoff (Bracht, 1970; Glass, in Wittrock & Wiley, 1970).

Whether one looks at the era of empirical research in media, the

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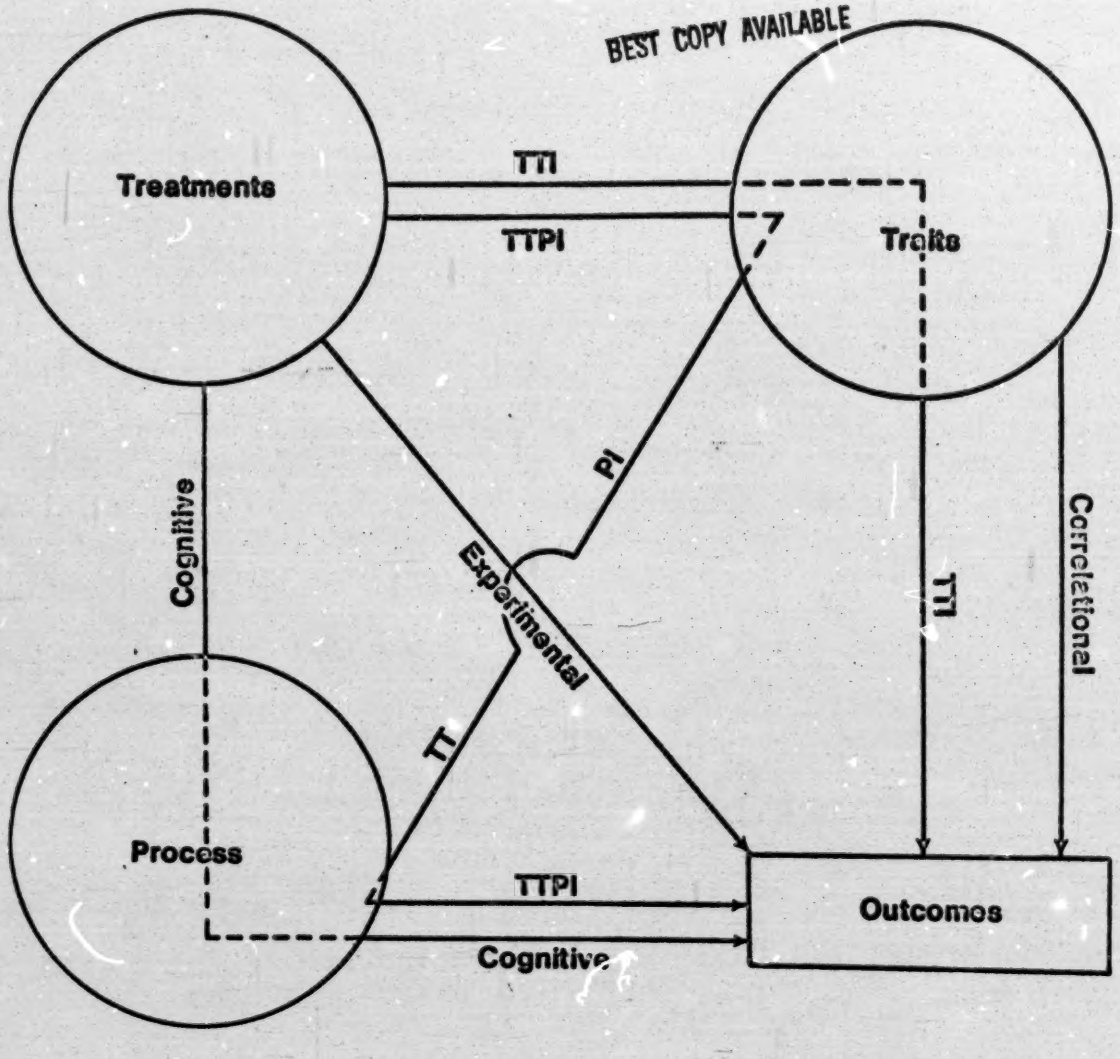

Figure 1. A description of several experimental approaches. Correlational methods compare rankings of measures on traits with rankings on other behaviors or outcomes. Experimental methods ignore individual differences and compare the influence of environmental events, i.e., treatments on outcomes. Cognitive processes orientations consider what these environmental events cause the individual to do and how this information-processing influences outcomes. The TTPI approach is essentially the cognitive process approach coupled with traits implying that both traits and treatments interact in combination with the way material is processed to affect outcomes. (Based on Di Vesta, 1973).

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influence of the behavioristic position, or the TTI approach, it can be seen that each has made its contribution to a theoretical foundation for media research. While there was nothing wrong in the initial premises of each approach, each failed in not extending some aspect of methodology or theory. Thus, the early empiricist tradition erred in being atheoretical. Research based on the behavioristic position, while being somewhat theoretical, erred in neglecting to recognize that input variables have more than mechanical effects on human responses, a position well-summarized by McKeachie (1974). The first version of the TTI position may have been ineffective because investigators failed to provide for the possibility that traits interact not only with treatments but also with the strategies learners or receivers of information employ in processing the information. Both traits and treatments may affect, and in some cases will dictate whether the receiver will attend, to what he attends, whether he will try to learn by rote or for understanding, whether he will form images or verbal statements, whether he prefers to use the visual over the auditory modality, and so on.

The next logical development in the TTI approach is one which has been suggested almost simultaneously by a number of investigators (Di Vesta, 1973; Glaser, 1972; Koran, 1972; Hunt, 1973). In a word, they suggest that the theory underlying TTI research must consider the cognitive processes assumed to be correlated with traits and/or the processes induced by the treatments if such research is to be fruitful. This point of view is especially

compatible with the use of media and should encourage media specialists to focus on al large body of already available literature from an appropriate theoretical position to an extent impossible in previous eras.

Now for some guidelines for describing processing variables. Ausubel (1968) proposes two basic processes in meaningful learning, which are useful in thinking about information-processing in media research: perception and cognition. Perception is the immediate content of awareness before the intervention of cognitive processes. Involved in perception is the fact that people don't attend to everything in the stimulus field, there is too much of it. What they see depends on what they know... on their expectations, prior experiences, goals, and values. Accordingly, they scan the field in systematic ways, they monitor, even though they don't attend directly to, the "noise" part of the field; they select things to attend to; and they can learn strategies for perceiving. They may even construct part of their perceptions...i.e., they may "see" things that aren't there and they may not see things which are there. Involved in cognition, i.e., thinking, are such processes as associating in which the receiver relates new material to what he already knows; conceptualizing in which he forms or enlarges categories of events; and inferring in which the receiver uses both new and old information to form new relationships...i.e., to generate new knowledge. New information is encoded for storage and stored information is recycled. A detailed extension of this general orientation has been made in other publications (Di Vesta, 1972; 1974).

The moment we concern ourselves with the information processing approach we are confronted with a host of hypothesized processing events that seem all too reasonable in thinking about the media. We may even wonder why they had not been of concern to investigators in the past decade. Among these processes are the registering of stimuli, scanning the stimulus field, selecting events, coding and storing materials, and retrieving materials. Each of these processes can be influenced by such individual differences as: What the person already knows, i.e., his knowledge; by what he can do, i.e., his aptitudes or capacities; by what he tends to do, i.e., his preferences; and, by the kinds of plans he employs for approaching tasks whether viewing a movie or listening to a lecture, i.e., his strategies.

In information-processing, as it applies to the media, there are several classes of events:

(a) Events antecedent to learning, viewing, or listening: These include everything that has happened before the person engages in the task...his traits, learned strategies, sets, expectancies, dispositions. Consideration of these events is the source of theories about individual differences. But pre-learning events ought also to include such factors as instructions or other preparation administered to the learner, listener, or viewer.

(b) Events simultaneous with the presentation of the material itself: They include attending, perceiving, registering, selecting, coding, and storing. Although these events can be sources of individual differences, they also interact with individual differences.

(c) Events subsequent to the learning task. These include organization or reorganization of the material as the material is used and the use of the material in retrieval and transfer.

As indicated in the foregoing paragraphs, while many antecedent events can be classified as individual difference variables some, such as instructions to the learner, are manipulable independent variables. Events which occur simultaneously with the presentation of materials such as contextual arrangements, presentation modality, density of stimuli, or time of exposure are of major concern to the media researcher. It is precisely at this point that analyses of materials, their organization and presentation, must be made in terms of the kinds of processes the learner uses. We must also know which individual differences might be engaged in the use of these processes, and what effects might result at the time of acquisition, retrieval, or transfer as a consequence of the interaction between individual differences and treatments.

Examine, for illustrative purposes, a few of the differences between printed and tape-recorded material. They are different in terms of their obvious physical characteristics of ink and magnetic tape. But, they also involve different sensory modalities which become important in a variety of processing activities such as the sensory registers involved and the part of the brain engaged in receiving and interpreting the message. Often overlooked, probably because it is so obvious, is the simple fact that reading material is spatially presented while recorded messages are

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temporally presented. At this point, it can be seen that the implications for processing become broadened considerably: Visual messages engage the visual sensory register; aural messages engage the aditory sensory register. Visual messages require less attention,because they can be reviewed,than do aural messages. For the same reason greater demands are made on short-term memory and on coding processes in aural than are made in visual messages.To extend this further, we can even find differences in primacy and recency learning effects as will be described in more detail below. Also of interest is the reliable finding that imagery in either the visual or auditory modality interferes with attention to perception of different materials presented in the same modality (Segal & Fusella, 1970).

The applicability of such findings to theories for guiding media research can be illustrated in a limited way by linking the findings of a few selected studies. One reliable finding is that adults have preferences for visual information, i.e., they are more likely to attend to visual than to auditory stimuli and with increases in age children pay increasingly more attention to visual information and increasingly less attention to auditory information (Lordahl, 1961; Stevenson & Siegel, 1969). And, the advantage of visual over auditory material increases for more difficult material (Schultz & Kasschau, 1966).

In still another study, Ingersoll and Di Vesta (1972) first identified "visual" attenders and "aural" attenders among college Ss by simultaneous presentation of different 5-digit spans visually and aurally. After presentation of the stimuli the S was to recall as many digits as possible. The modality in which the greatest number of digits was recalled correctly

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was used to classify the S as a visual or aural attender. On a second task the Ss were presented two sets of five words simultaneously: one set aurally, the other visually. Then the Ss were visually presented each set with one of the words missing. The task was to identify the word missing from the set originally presented in each modality. This an impossible task unless one assumes that people develop consistent and selective information-processing strategies which become automatic. This interpretation was supported by a disordinal interaction showing that aural attenders made more errors on visually presented stimuli than on aurally presented stimuli and visual attenders made more errors on aurally presented stimuli than on visually presented stimuli. But, more interesting from a theoretical view was the finding that visual attenders showed marked primary influence while aural attenders showed marked recency effects in recall, thereby indicating not only differences in what was processed but differences in how it was processed. The implications of this study are clear: If the distinction between aural-visual attenders is stable, and generalizable to a wide range of tasks, then people who have such stable response strategies may be at a disadvantage to the extent that information presented on the two channels in audio-visual presentations departs from redundancy.

It would be easy to extend this illustration to other hypotheses: for example, are there separate field-dependency traits for aural attenders and visual attenders or is field dependency a more generalized trait? In either case, how does field dependency affect the learner's ability to monitor or extract relevant information from a background of noise, as is sometimes the case when concepts are being taught, i.e., when the same feature must

be abstracted from varying contexts? Then, how is performance affected when these concepts are being taught through visual presentations and aural presentations with variations in "noise" operationally defined as objective noise, e.g., masking noise partially obliterating the sounds of a verbal message, or as conceptual noise, e.g., the embedding of the relevant feature in extraneous material needed, in the teaching of a concept, to achieve generalizability.

There is still another test of the differences between aural/visual attenders which is of theoretical importance and which remains to be done. It is complexly related to the role of context in learning (Bransford & Johnson, 1972). Briefly, advance organizers implemented in the form of productive contexts through brief paragraphs, labels, or pictures can make the difference between understanding and not understanding a message. Context also has major effects on how much is remembered from a message as well as on confidence one has in what was remembered. Coordinate with the cognitive orientation that I have proposed, I would hypothesize further that the nature of the context will determine what is processed, perhaps how it is to be processed, and, certainly, will even affect the outcomes of processing.

There are endless possibilities for media research involving contextual arrangements. As one example, context can be varied in terms of the relationships between verbal and visual messages (in such media as sound motion pictures or sound filmstrips) along a continuum of complete correspondence or redundancy at one extreme to complete conflict at the other extreme. If context is viewed as an organizer showing the learner the relation between what he knows and what he is about to learn then its usefulness ought to interact

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with the learner's degree of knowledge, with his degree of verbal ability, and perhaps, with his ability to image. Beyond such studies are the needs to examine how media can be employed (a)to link what the learner knows to the new material being learned and (b) to provide different organizations of subject matter for meeting different objectives such as the development of concepts, attitudes, or skills. Casual observation suggests that these factors have been informally considered at a tacit or intuitive level by users of the media but the effects of these and related factors have not been subjected to systematic investigations.

Space does not permit a complete review of the literature related to the TTI-Process approach although such a review is sorely needed at this juncture. An initial and useful step in this direction may be found in Levie and Dickie's (1973) review in the Second Handbook of Research on Teaching (Travers, 1973). However, it seems possible that the time may be right for a more theoretically oriented review integrating the work of research investigators concerned with information-processing including the current group of cognitive psychologists (e.g., Branford & McCarrell, in press), researchers on TTI (e.g., Cronbach & Snow, 1968), and researchers on sensory processing (e.g., Broadbent, 1958).

In brief, the TTI-Process approach is particularly adapted to the study of information-processing by receivers of information presented in the media. Differences in people's experiences do lead to different cognitive structures. Different people use the same machinery of perceiving, coding, storing, and

retrieving. Nevertheless, how they use this machinery, what information they process by this machinery, and which particular use of a given piece of machinery they prefer, will make a major difference in knowledge structures leading to an enormous variety of individual differences. Even very small differences in environment and experience can make large differences in knowledge structures including the learner's knowledge about how to process information, even though it is probably true that the underlying machinery is the same for all learners.

Systematic investigations on the media based on TTI-Process oriented theories appear now to hold the promise of making a major impact on our understanding of the communication process as well as on our understanding of human behavior. In terms of the theories, technology, and research methods that the task requires there has never been a more opportune time. Linked with sound theories of information-processing and individual difference variables it is even conceivable that the early studies of the effects of more global variables can be meaningfully replicated in more sophisticated fashion.

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